RX-RM
INSECT SURVEY PROGRAM
Reports
(Spruce Budworm)

SPRUCE BUDWORM INFESTATIONS IN NEW MEXICO AND ARIZONA

Appraisal Survey
Season of 1954

by

J. W. Bongberg and R. K. Bennett, Entomologists
Rocky Mountain Forest and Range Experiment Station
Forest Insect and Disease Laboratory
Albuquerque, New Mexico
February 3, 1955

SUMMARY

The spruce budworm (Choristoneura fumiferana) has developed to epidemic proportions over an area of approximately 1,000 000 acres in the mixed-conifer and spruce-fir forests in New Mexico and Arizona during the past few years. Infestations became more intensive in all areas during 1954. Severe mortality is occurring in understory trees; merchantable-sized trees are being top-killed; and in some areas tree mortality has begun in the merchantable stand. The seriousness of spruce budworm infestations in all areas is magnified by a general increase in populations of several species of tree-killing bark beetles.

The general scope and severity of spruce budworm infestations and the associated bark beetle problem in New Mexico and Arizona was reported to the Southwest Forest Pest Study and Action Committee early in 1954. The Committee recommended an intensive survey by the Rocky Mountain Forest and Range Experiment Station to locate areas of infestation and to delineate degree of defoliation. The survey was accomplished by use of aerial and ground procedures. All areas of spruce budworm defoliation were delineated and mapped in place by a 3-man survey crew from the air. Subsequent to the aerial phase of the survey, field crews checked infestation areas on the ground to correct errors made in delineation of defoliation on the aerial maps.

The survey of the two southwestern states during 1954 revealed that a total area of 869,600 acres of mixed-conifer and spruce-fir timber type was infested by spruce budworm in intensity ranging from light to severe. Light to moderate infestations prevail in all areas in Arizona, but defoliation of more severe proportions occurs over much of the susceptible timbered areas in northern New Mexico.

If continued defoliation and subsequent tree mortality is to be prevented, chemical control should be initiated without delay. If all areas of infestation cannot be treated, priority should be given to those in New Mexico.

The spruce budworm infestations in both states have been delineated into well defined entomological units as indicated on the appended map. Each unit is isolated by an expanse of nontimbered areas or nonsusceptible type; therefore, treatment could be accomplished on each unit individually without likelihood of reinfestation from adjacent areas. All areas of infestation within a given infestation unit must be sprayed. With proper administration of a control project and adequate technical supervision, successful results can be expected.

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INTRODUCTION

The spruce budworm (Choristoneura fumiferana) is one of the most serious insect pests of the mixed-conifer and spruce-fir forests of the Western United States. In recent years large-scale outbreaks of this insect have developed throughout most of the susceptible timber type in the Pacific Northwest and much of the Rocky Mountains extending from the interior of Canada southward to near the Mexican border. Since 1950, increased populations of spruce budworm in New Mexico and Arizona have kept pace with rising infestations elsewhere in the West.

Douglas-fir, white fir, and corkbark fir are the preferred hosts in New Mexico and Arizona. Engelmann spruce and blue spruce are also attacked, particularly in areas where the spruce stand occurs at the lower elevations and in mixture with infested fir species. To date, budworm infestations of sufficient intensity and duration to kill mature trees have been restricted to localized areas within the outbreaks. Repeated defoliation of understory trees during the past 4 years has caused severe mortality of seedlings, saplings, and small poles over large acreages where susceptible tree species comprise the bulk of the understory stand. Coupled with tree-weakening as a result of continued defoliation by the spruce budworm has been a noticeable upsurge of activity by the Douglas-fir beetle, the fir engraver beetle, and the western balsam bark beetle in several areas.

During the past 4 years local outbreaks in isolated areas in New Mexico were treated by aerial application of DDT.

Delineation of Infestation by Aerial Methods

The task of delineating spruce budworm infestations throughout the mixed-conifer stands of New Mexico and Arizona was a formidable undertaking with the limited manpower. Even though many areas of infestation were known prior to the onset of the 1954 season, complete area coverage of all susceptible timber type in the two states was necessary to insure an up-to-date delineation of all areas.

Aerial procedures developed by the Pacific Northwest Forest and Range Experiment Station were used to delineate the areas of infestation. The method provides in-place mapping of all infestations visible from

the air. A Cessna 180, 4-place, high-wing, single-engine monoplane was used for all of the aerial mapping work. The services of the airplane and expert pilot were made available by the Aircraft and Special Equipment Center, Agricultural Research Service. Mr. W. J. Buckhorn, Entomologist, was detailed from the Portland Forest Insect Laboratory, to act as Chief Observer.

The mapping of budworm infestations was accomplished during the period from June 28 to July 5 by a 3-man crew consisting of pilot and 2 observers. The chief observer occupied the forward seat in the plane adjacent to the pilot and "mapped-in-place" all budworm infestations that were visible. Excellent forward and lateral visibility enabled accurate plotting of infestations for a lateral distance of 2 miles to the right of the plane's line of flight. Infestations for a similar lateral width to the left of the plane were observed by the third member of the survey crew occupying the seat immediately behind the pilot and related to the chief observer for mapping. Flight lines were run along parallel courses at approximately 4-mile intervals except over deep canyons and rough terrain where contour flight lines were employed.

Areas of tree defoliation were easily recognized from the air by the brownish discoloration of foliage resulting from dead needles partially consumed by the budworm larvae. Foliage discoloration as an indication of the degree of current budworm infestation was supplemented in areas of heavy defoliation by a thin appearance of the crown canopy in the trees. Four degrees of defoliation were discernible during the course of the aerial survey, and the degree of defoliation was recorded on the maps by use of a color code for differentiation. Color codes representing degree of defoliation as used during the course of the survey are as follows:

1. Blue: Light defoliation. Killing of understory and overstory trees not imminent.
2. Green: Moderate defoliation. Considerable tree-killing in understory; no tree-killing imminent in overstory.
3. Orange: Defoliation severe. Heavy mortality in understory trees; moderate top-killing and some tree-killing in overstory.
4. Red: Defoliation very severe. Complete mortality in understory trees and severe tree-killing in overstory stand.

Ground Checking of Defoliation as Delineated by Aerial Methods

At the completion of the aerial phase of the regional spruce budworm survey, ground checks were made to correct and adjust errors in the boundaries of degree of defoliation. The extensive infestations precluded systematic ground sampling of all areas; therefore, spot checking of the borders of infestation was substituted. Spot checks were made along existing roads in so far as possible and supplemented by checks from travel by foot and horseback in remote areas. By subdividing the designated areas of defoliation and checking each drainage, the ground

survey work was accomplished in an orderly manner. Corrections in infestation areas were made on field maps and later transferred to master copy maps maintained at the Laboratory. All aerial and ground map work employed the use of planemetric base maps, scale 1 inch to 2 miles. The ground checking of infestations was completed by October 1 by a crew of 3 men working 8 weeks.

Compilation of Survey Findings

Upon completion of the field work, acreages of infestation were segregated according to degree of defoliation, class of ownership, and area. The infestations were then subdivided into seven distinct and separate geographical units to facilitate description and their use as control units. The location and magnitude of the spruce budworm infestations are shown on the appended map and chart. Each control operation, none of which exceeded 5,000 acres in size, was highly successful in reducing budworm populations to endemic status in the areas treated. During 1953, however, spruce budworm populations showed a material increase in severity throughout most of the mixed-conifer stands of both New Mexico and Arizona, and it became apparent that treatment might be necessary over larger areas.

The severity of the spruce budworm infestations in portions of New Mexico and Arizona was reported to the Southwest Forest Pest Study and Action Committee on January 29, 1954, when it became apparent that continued defoliation would kill many trees outright or make them susceptible to bark beetle attack. The Action Committee recommended that an intensive survey be made of the budworm infestations in both states to appraise the problem. Accordingly, the surveys were planned and executed by the Rocky Mountain Forest and Range Experiment Station during the 1954 season.

REGIONAL SPRUCE BUDWORM SURVEY

Survey Procedures

The survey program in New Mexico and Arizona during 1954 was a 2-phase operation patterned after the spruce budworm surveys in the Pacific Northwest. Invaluable assistance was given by the Pacific Northwest Forest and Range Experiment Station in both planning and executing the survey.

Unit Area Descriptions

1. Pecos Entomological Unit

This unit, comprising a total area of approximately 900,000 acres, occupies the southern portion of the Sangre de Cristo Mountains in the Santa Fe and Carson National Forests in northern New Mexico. Landownership in this unit is largely federal, including approximately 137,000 acres in the Pecos Wilderness Area. About one-fifth of the land area, but a lesser amount of the infestation, is located on private lands

within the borders of the Rancho del Rio Grande, Picuris, Rosario and Mora Land Grants. Sawtimber utilization is at present restricted by the steep terrain, except on approximately 100,000 acres in the Upper Rio Pueblo drainage, an area east of the Pecos River, and on the Rancho del Rio Grande Land Grant. Watershed and recreation values of the unit are high.

Defoliation throughout the Pecos Unit ranges from light to heavy. The light infestations occur primarily in the northern portion of the area with heavier infestations throughout the Upper Pecos River drainage; in the Cow Creek and Bull Creek drainages; and along the western slope of the Sangre de Cristo Mountains in the southern portion of the unit (see appended map). The acreages of spruce budworm infestations in the Pecos Unit, by degree of defoliation and class of landownership, are given in Table 1.

Table 1.--Acreage and class of landownership. Spruce budworm infestations, Pecos Unit, Santa Fe and Carson National Forests, New Mexico

Degree of defoliation	Acres of Infestation			
	Federal*	State	Private	Total
Light	108,960	None	32,000	140,960
Moderate	100,480	None	3,840	104,320
Heavy	15,040	None	480	15,520
Very Heavy	None	None	None	None
Total	224,480		36,320	260,800

*Includes small acreage of private land in homesteads and mining claims surrounded by National Forests.

2. Baca Entomological Unit

The Baca infestation unit comprises an area of approximately 700,000 acres in the Western Division of the Santa Fe National Forest in northern New Mexico. Landownership in the areas of infestation is a mixture of federal lands and large private holdings. Major private ownership includes the Land Grants of Canyon de San Diego, Polvadera, and Baca Location Number 1. The mixed-conifer timber that predominates throughout this unit is of high quality. Timber production from the area supports several of the major sawmills in the state.

The spruce budworm infestations in the Baca Unit are most severe along the western edge of the timber type intermingled on federal and private lands. The long duration of infestations throughout most of the unit have resulted in heavy killing of understory trees, top-killing in the overstory trees, and, in some areas, death of a considerable percentage of the susceptible stand. The acreages of infestations in the Baca Unit, by degree of defoliation and class of ownership, are given in Table 2.

Table 2.--Acreage and class of landownership. Spruce budworm infestations, Baca Unit, Santa Fe National Forest, New Mexico

Degree of defoliation	Acres of Infestation			
	Federal*	State	Private	Total
Light	90,080	None	42,560	132,640
Moderate	63,200	None	27,200	90,400
Heavy	16,160	None	7,680	23,840
Very Heavy	640	None	None	640
Total	170,080		77,440	247,520

*Includes small acreage of private lands in homesteads and mining claims surrounded by National Forests.

3. Tierra Amarilla Entomological Unit

The Tierra Amarilla Unit comprises an area of approximately 750,000 acres in the Western Division of the Carson National Forest and adjacent private lands. The Unit is primarily a high plateau sloping downward in all directions except to the north. This area supports a high value stand of mixed-conifer and spruce-fir timber. A wide belt of mixed-conifer timber adjoining the lower edge of the spruce-fir timber type is heavily infested by spruce budworm. The intensity and long duration of the infestations throughout the mixed-conifer timber type has resulted in severe mortality of the understory trees. Considerable top-killing has occurred in the overstory stand during the past two years, and tree mortality has started in areas of severe defoliation.

The acreages of infestations in the Tierra Amarilla Unit, by degree of defoliation and class of landownership, are given in Table 3.

Table 3.--Acreage and class of landownership. Spruce budworm infestations, Tierra Amarilla Unit, Carson National Forest and adjacent private lands, New Mexico

Degree of defoliation	Acres of Infestation			
	Federal*	State	Private	Total
Light	17,600	None	8,000	25,600
Moderate	72,640	None	30,400	103,040
Heavy	11,360	None	2,080	13,440
Very Heavy	None	None	None	None
Total	101,600		40,480	142,080

*Includes small acreage of private lands in homesteads and mining claims surrounded by National Forests.

4. Sacramento Entomological Unit

The Sacramento Unit comprises an area of approximately 300,000 acres in the Sacramento Division of the Lincoln National Forest and a portion of the Mescalero-Apache Indian Reservation in southern New Mexico. With the exception of small homesteads and other patented lands, the area of infestation is federally-owned or managed. The mixed-conifer timber throughout the Sacramento Unit is of high value with a sustained yield capacity of some 20,000 M b.f. annually.

The mixed-conifer timber in the Sacramento Unit has been subjected to repeated defoliation by spruce budworm and New Mexico fir looper during the past several years. Aerial spraying was done to control the looper and budworm infestations on 12,000 acres during 1952. In 1954, an additional 3,500 acres of severe spruce budworm infestation were sprayed. Currently, a majority of the spruce budworm infestation in the Sacramento Mountains is of light or moderate intensity. The control during 1952 and 1954 averted major tree-killing from budworm feeding. If the budworm populations remain at current levels for another 2 years, severe damage can be expected to understory and overstory trees.

The acreages of spruce budworm infestations in the Sacramento Unit, by degree of defoliation and class of landownership, are given in Table 4.

Table 4.--Acreage and class of landownership. Spruce budworm infestations, Sacramento Unit, Lincoln National Forest and Mescalero-Apache Indian Reservation, New Mexico

Degree of defoliation	Acres of Infestation			
	Federal	State	Private	Total
Light	72,640*	None	None	72,640
Moderate	19,520	None	None	19,520
Heavy	2,400	None	None	2,400
Very Heavy	None	None	None	None
Total	94,560			94,560

*Includes 15,040 acres on Mescalero-Apache Indian Reservation.

5. Mt. Taylor Entomological Unit

The Mt. Taylor infestation unit is an isolated tract of spruce and mixed-conifer timber on the Cibola National Forest in central New Mexico. In large part, the pine timber from a majority of the area has been logged in past years leaving the mixed-conifer and spruce-fir on approximately 10,000 acres on the upper slopes of the mountain. Although a majority of the area currently infested by spruce budworm is relatively inaccessible to logging and recreational use, the adjacent susceptible type which was treated in 1953 is of high commercial value.

A 3,500-acre area of severe spruce budworm infestation on the north slope of Mt. Taylor was treated by aerial spraying during 1953. The treated portion of the infestation unit is still relatively free from spruce budworm populations. Since 1953, defoliation has become severe throughout the mixed-conifer stands in the Water Canyon drainage east of the control area, killing some of the understory and a limited amount of the overstory stands.

The acreages of spruce budworm infestations in the Mt. Taylor Unit, by degree of defoliation and class of landownership, are given in Table 5.

Table 5.--Acreage and class of landownership. Spruce budworm infestations, Mt. Taylor Infestation Unit, Cibola National Forest, New Mexico

Degree of defoliation	Acres of Infestation			
	Federal	State	Private	Total
Light	480	None	None	480
Moderate	320	None	None	320
Heavy	3,040	None	800	3,840
Very Heavy	None	None	None	None
Total	3,840		800	4,640

6. Kaibab Entomological Unit

The Kaibab infestation unit comprises a gross area of approximately 200,000 acres on the Kaibab Plateau in northern Arizona. The spruce budworm infestation within the unit occurs in approximately even proportions on the Kaibab National Forest and the Grand Canyon National Park. None of the infestation occurs on private lands.

Close watch has been maintained of the trend of spruce budworm infestations in the Kaibab Unit for the past several years. There has been some evidence of a normal decline of populations during 1953 and 1954. A small portion of the stand in the infestation area has been severely defoliated during the past several seasons and some mortality of understory trees has occurred. For the most part, budworm defoliation has not caused severe damage to overstory trees. Unless the apparent downward trend of current budworm populations is reversed, the infestations throughout the Kaibab Unit are not viewed with alarm, even in the National Park area which is a heavily-used recreational area.

The acreages of spruce budworm infestations in the Kaibab Unit, by degree of defoliation and class of landownership, are given in Table 6.

Table 6.--Acreage and class of landownership. Spruce budworm infestations, Kaibab Infestation Unit, Kaibab National Forest and Grand Canyon National Park, Arizona

Degree of defoliation	Acres of Infestation				
	Federal				
	Forest Service	Park Service	State	Private	Total
Light	27,680	39,520	None	None	67,200
Moderate	26,560	11,040	None	None	37,600
Heavy	6,400	None	None	None	6,400
Very Heavy	None	None	None	None	None
Total	60,640	50,560			111,200

7. Apache Entomological Unit

The Apache infestation unit, comprising an area of approximately 75,000 acres, is located in the White Mountains on the Fort Apache Indian Reservation and Apache National Forest in eastern Arizona. Current infestations of spruce budworm are confined to a narrow belt of mixed-conifer and spruce-fir timber extending along the north and east slopes of the mountains. Approximately one-third of the infested area is within the boundaries of the Mt. Baldy Wild Area on the Apache National Forest. Although a majority of the spruce budworm infestation in the Apache Unit occurs in areas thus far undeveloped for logging, timber values are high, constituting much of the resource planned for support of one of the state's largest sawmills.

The spruce budworm infestation in the Apache Unit has not developed to serious proportions even though three-fourths of the infested area was classed as being defoliated to a moderate degree during 1954. The acreages of spruce budworm infestations in the Apache Unit, by degree of defoliation and class of landownership, are given in Table 7.

Table 7.--Acreage and class of landownership. Spruce budworm infestations, Apache Infestation Unit, Fort Apache Indian Reservation and Apache National Forest, Arizona

Degree of defoliation	Acres of Infestation			
	Federal*	State	Private	Total
Light	2,720	None	None	2,720
Moderate	6,080	None	None	6,080
Heavy	None	None	None	None
Very Heavy	None	None	None	None
Total	8,800			8,800

*Includes lands within Fort Apache Indian Reservation.

RECOMMENDATIONS

The defoliation of mixed-conifer and spruce-fir timber stands as caused by infestations of the spruce budworm in New Mexico and Arizona has become severe during the past few years. Currently, infestations ranging from light to very heavy occur on nearly 1,000,000 acres in the two southwestern states. In many areas throughout the infestation, reproduction and other understory trees have been killed. In addition, top-killing and tree mortality in the merchantable timber has occurred in some areas. Continued defoliation in infested areas at intensities present during 1954 will accelerate the tree mortality rate; tree-killing will become general in the very heavily defoliated areas in 1955 and 1956 and within 3 years in the moderate and heavily defoliated areas.

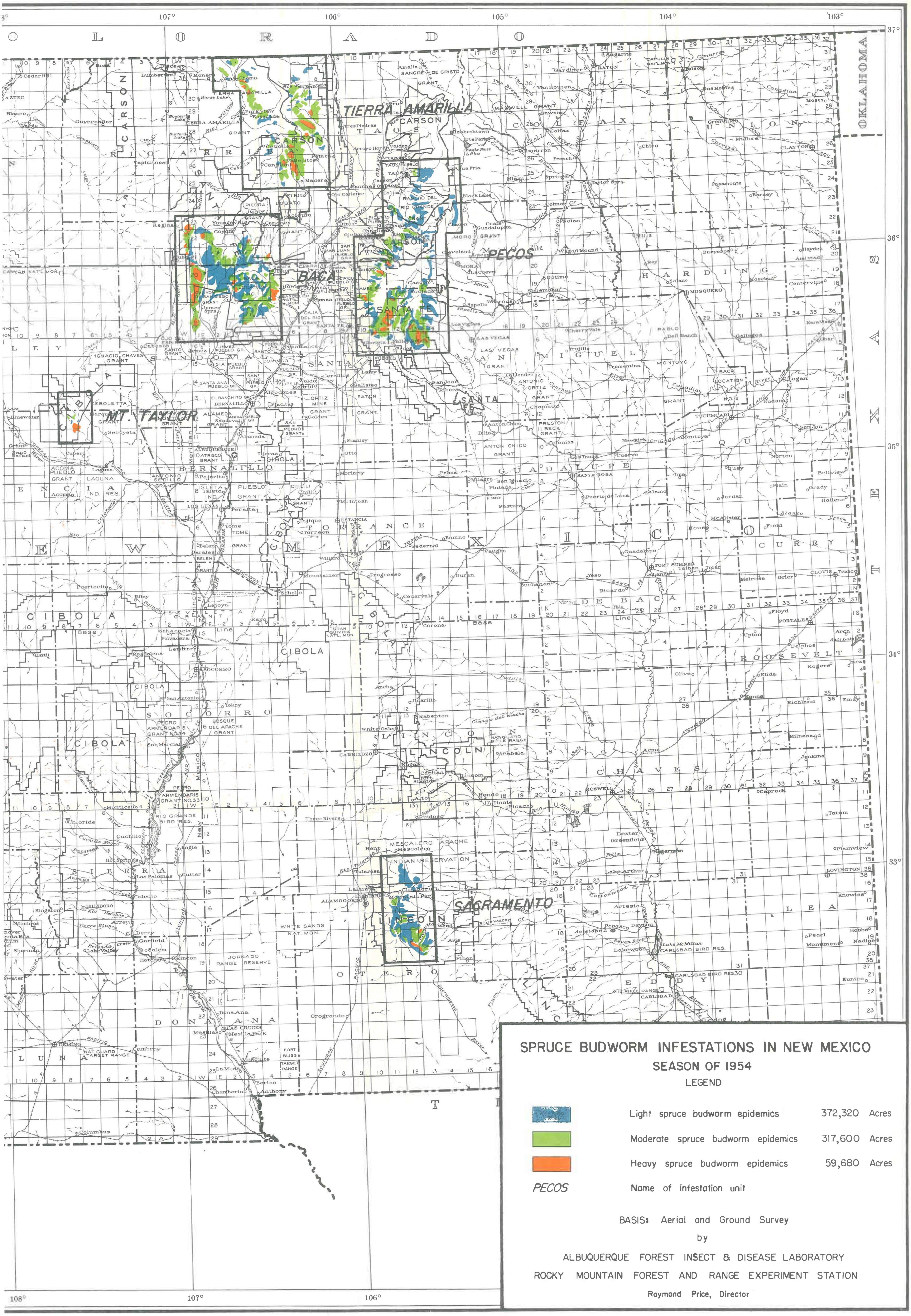
The seriousness of spruce budworm infestations is magnified by an overall increase of bark beetle populations in the defoliated stands. During 1953 and 1954, the Douglas-fir beetle, the fir engraver beetle, and the western balsam bark beetle have developed local epidemics in defoliated areas, killing as much as 25 percent of the stand. These outbreaks can be expected to enlarge in direct proportion to the degree of defoliation by the spruce budworm.

In view of this threat to large areas of valuable timber stands, artificial measures for control of spruce budworm infestations should be considered without delay.

In considering control action, operations must be planned for thorough coverage of infestation units to prevent reinfestation. The entomological units as referenced on the appended map are sufficiently isolated one from the other by large areas of nontimbered or nonsusceptible type as to afford adequate protection against reinfestation. It is essential, however, that all infested areas within each unit regardless of ownership be sprayed in the course of control operations to prevent reinfestation from such tracts within the unit.

On the basis of severity of spruce budworm infestations and timber values threatened in New Mexico and Arizona, the forests in northern New Mexico should receive high priority. In the event that control action is not possible in all areas of infestation , the priorities for treatment of the entomological units should be based upon the degree of defoliation and infestation, the threat to timber values, size of the units, and pattern of landownership.

Successful control of spruce budworm infestations by aerial application of formulated DDT insecticide has been demonstrated from the small-scale control operations in New Mexico during 1953 and 1954 and from larger projects in other western regions in past years. Successful control, however, demands that application of insecticide be timed to development of the budworm larvae and opening of new growth buds in the affected trees. Proper dosages of insecticide, height of spray application, and uniform spray coverage are also of utmost importance. It is mandatory, therefore, that plans for control of spruce budworm infestations should include provisions for technical supervision of all aspects of the control undertaking.


SPRUCE BUDWORM INFESTATIONS IN NEW MEXICO
SEASON OF 1954
LEGEND
Light spruce budworm epidemics 372,320 Acres
Moderate spruce budworm epidemics 317,600 Acres
Heavy spruce budworm epidemics 59,680 Acres
PECOS Name of infestation unit
BASIS: Aerial and Ground Survey
by
ALBUQUERQUE FOREST INSECT & DISEASE LABORATORY
ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION
Raymond Price, Director
TIERRA AMARILLA
CARSON
BACA
SANTA FE
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SACRAMENTO
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UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

ADDRESS REPLY TO
DIRECTOR
AND REFER TO

FORT COLLINS, COLORADO

RX-RM
INSECT SURVEY PROGRAM
Reports
(Spruce Budworm)

Dear Sir:

Enclosed is a report of current spruce budworm infestations in New Mexico and Arizona, as determined by aerial and ground surveys by entomologists and cooperating personnel at our Albuquerque Forest Insect and Disease Laboratory during the season of 1954.

The regional spruce budworm survey has revealed that nearly a million acres of mixed-conifer and spruce-fir forests in the two southwestern states are infested and that budworm populations and resultant tree defoliation has increased in severity in most areas during the 1954 season. Infestations of most severe proportions occur in northern New Mexico, although large areas in Arizona are severely affected. In many of the budworm-infested areas the understory trees have suffered severe mortality and top-killing. Loss of merchantable trees is expected to increase unless chemical measures are promptly employed for control.

The status of spruce budworm infestations throughout New Mexico and Arizona was reported to the Southwest Forest Pest Study and Action Committee in Albuquerque, New Mexico, on November 10, 1954, and to the Western Forest Pest Committee of the Western Forestry and Conservation Association in San Francisco, California, on December 8, 1954. The need for control of these infestations has received the endorsement of the above-named committees.

Sincerely yours,

Raymond Price

RAYMOND PRICE, Director

Enclosures